GROUP 13A

MULTIPOINT FUEL INJECTION (MPI) <4A9>

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GENERAL INFORMATION

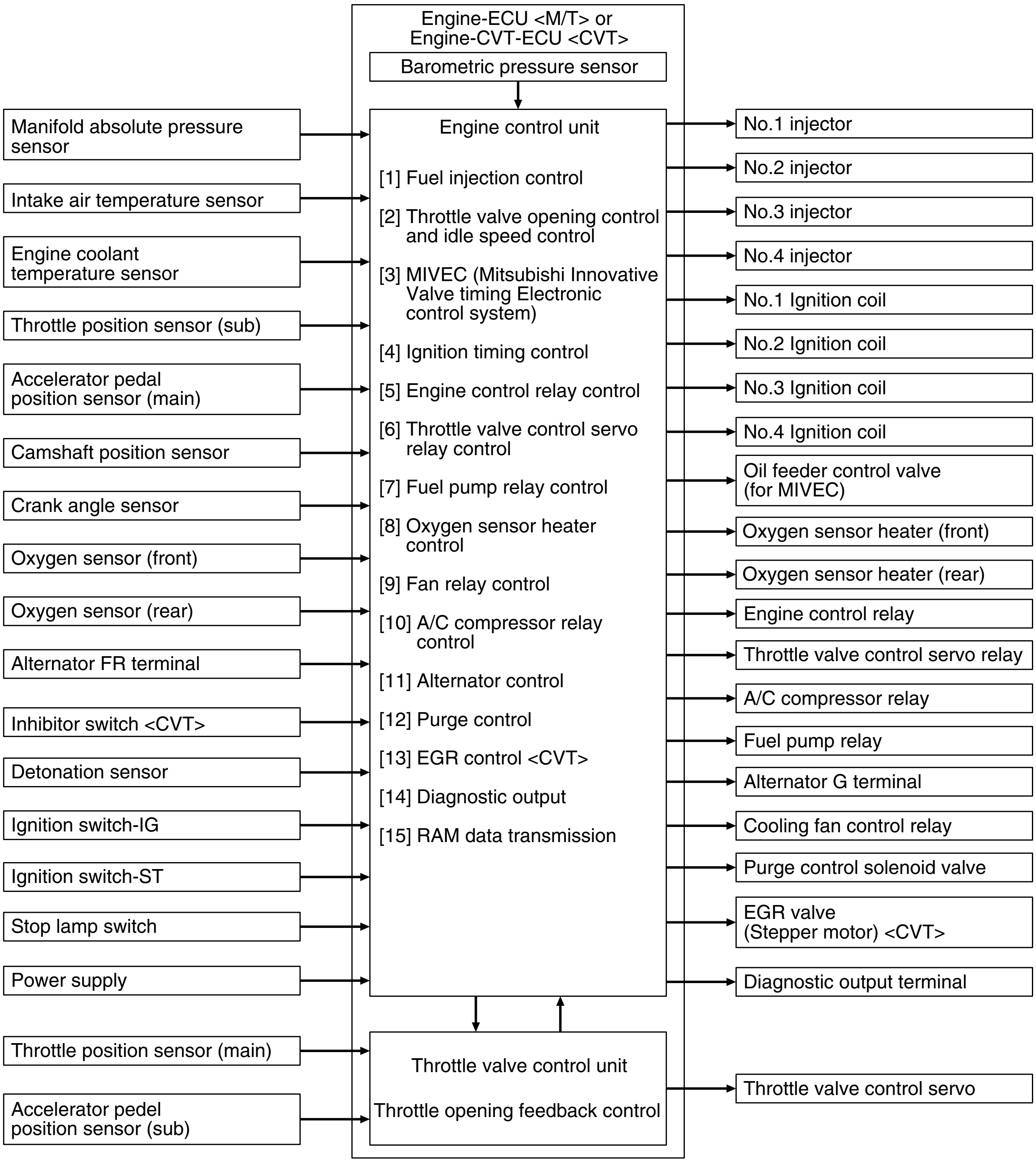
M2132000100990

Although the control systems are basically the same as those of the 4G1-Non-Turbo engine used in the COLT, the following improvements have been added.

Improvement	Remark
Dual oxygen sensor is used	Higher reliability of air-fuel ratio control
Fan relay control is changed	Abolish the two stage control of the fan rotating speed.

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SYSTEM BLOCK DIAGRAM



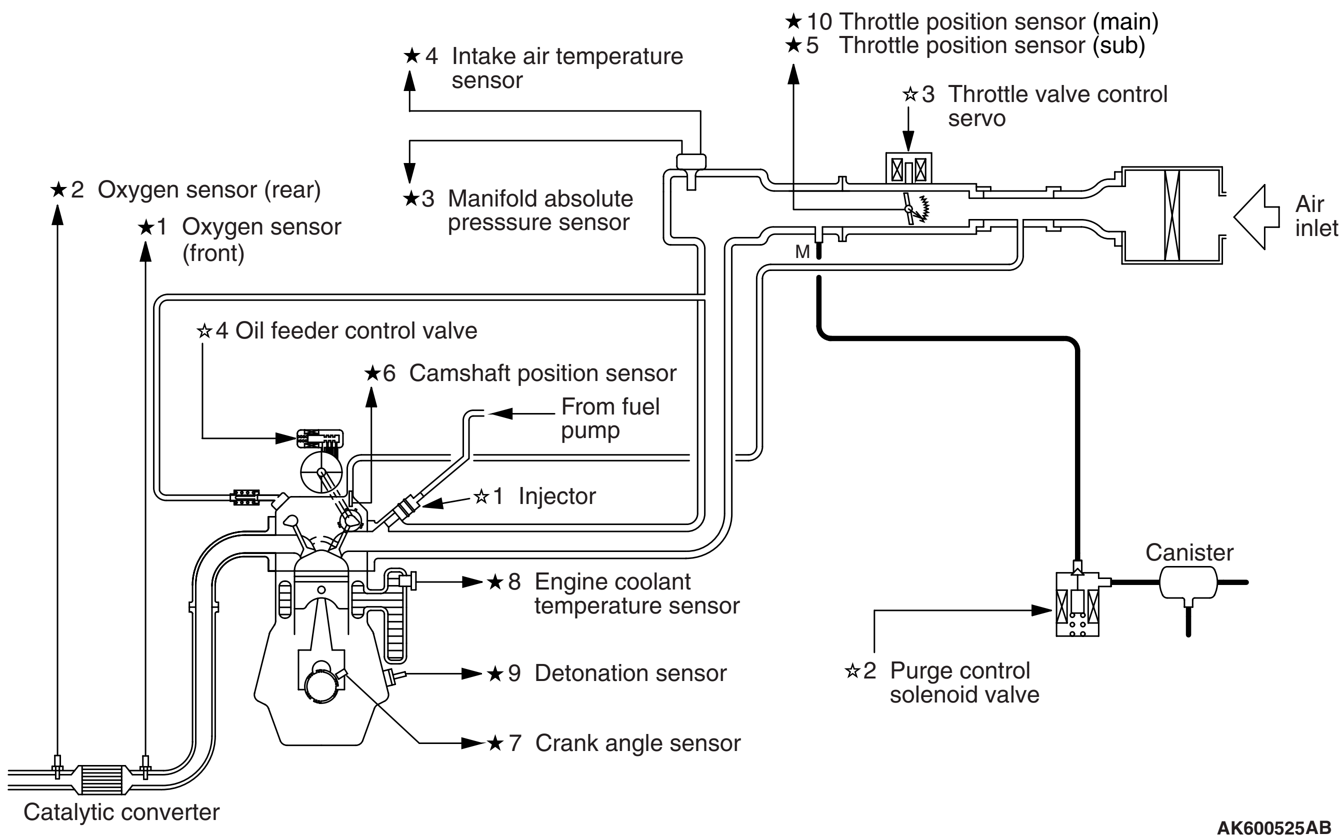
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CONTROL SYSTEM DIAGRAM

<M/T>

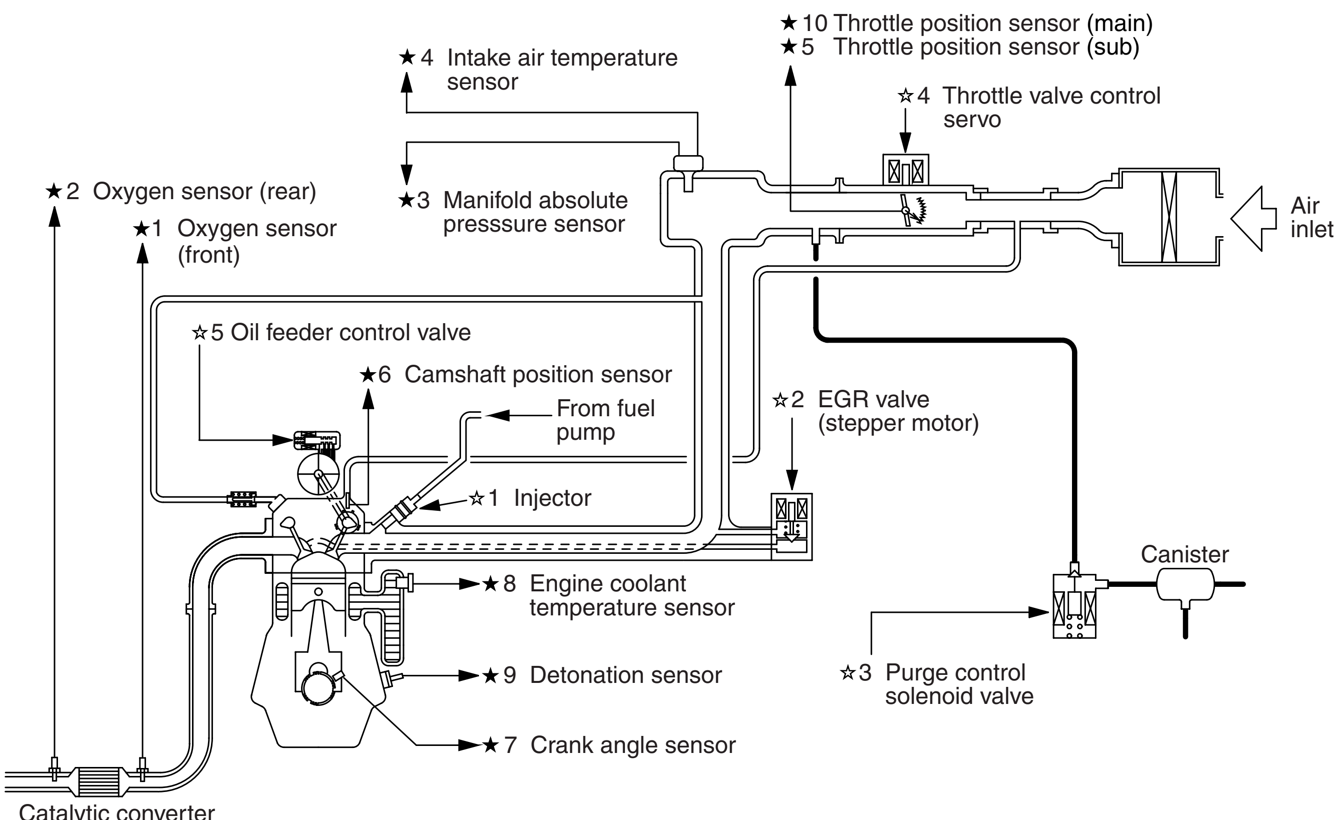
★1 Oxygen sensor (front) ★2 Oxygen sensor (rear) ★3 Manifold absolute presssure sensor ★4 Intake air temperature sensor ★5 Throttle position sensor (sub) ★6 Camshaft position sensor ★7 Crank angle sensor ★8 Engine coolant temperature sensor ★9 Detonation sensor ★10 Throttle position sensor (main)	● Power supply ● Ignition switch-IG ● Ignition switch-ST ● Accelerator pedal position sensor (main) ● Accelerator pedal position sensor (sub) ● Alternator FR terminal ● Stop lamp switch	⇨ Engine-ECU ● Barometric pressure sensor ⇨	☆1 Injector ☆2 Purge control solenoid valve ☆3 Throttle valve control servo ☆4 Oil feeder control valve	● Engine control relay ● Fuel pump relay ● A/C compressor relay ● Throttle valve control servo relay ● Ignition coil ● Cooling fan control relay ● Diagnosis output ● Alternator G terminal ● Oxygen sensor heater (front) ● Oxygen sensor heater (rear)



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<CVT>

★1 Oxygen sensor (front) ★2 Oxygen sensor (rear) ★3 Manifold absolute presssure sensor ★4 Intake air temperature sensor ★5 Throttle position sensor (sub) ★6 Camshaft position sensor ★7 Crank angle sensor ★8 Engine coolant temperature sensor ★9 Detonation sensor ★10 Throttle position sensor (main)	● Power supply ● Ignition switch-IG ● Ignition switch-ST ● Accelerator pedal position sensor (main) ● Accelerator pedal position sensor (sub) ● Inhibitor switch ● Alternator FR terminal ● Stop lamp switch	⇨	Engine-CVT-ECU ● Barometric pressure sensor	⇨	☆1 Injector ☆2 EGR valve (stepper motor) ☆3 Purge control solenoid valve ☆4 Throttle valve control servo ☆5 Oil feeder control valve	● Engine control relay ● Fuel pump relay ● A/C compressor relay ● Throttle valve control servo relay ● Ignition coil ● Cooling fan control relay ● Diagnosis output ● Alternator G terminal ● Oxygen sensor heater (front) ● Oxygen sensor heater (rear)



AK403079AC

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List of Component Functions

Name	Function
ECU	
Engine-ECU <M/T> or engine-CVT-ECU <CVT>	The signals that are input by the sensors enable the actuators to be controlled in accordance with the driving conditions.
Sensors	
Ignition switch-IG	This signal indicates the ON/OFF condition of the ignition switch. When this signal is input, the engine-ECU <M/T> or engine-CVT-ECU <CVT> supplies power to the crank angle sensor, camshaft position sensor, etc.
Ignition switch-ST	This signal indicates that the engine is cranking. Based on this signal, the engine-ECU <M/T> or engine-CVT-ECU <CVT> controls the fuel injection, throttle valve position, and the injection timing that are suited for starting the engine.
Manifold absolute pressure sensor	Uses a pressure conversion element to detect the pressure in the intake manifold, converts it into a voltage signal, and outputs it to the engine-ECU<M/T> or engine-CVT-ECU<CVT>. The engine-ECU<M/T> or engine-CVT-ECU<CVT> optimally corrects the fuel injection amount and the like based on this signal.
Oxygen sensor <front, rear>	This sensor, which contains zirconia and platinum electrodes, detects the level of oxygen concentration in the exhaust gases. The engine-ECU <M/T> or engine-CVT-ECU <CVT> determines whether the air-fuel ratio is at the optimal stoichiometric ratio in accordance with this oxygen concentration level.
Barometric pressure sensor	This sensor detects the altitude of the vehicle. It enables the engine-ECU <M/T> or engine-CVT-ECU <CVT> to make fuel injection volume corrections in order to achieve an appropriate air-fuel ratio.
Intake air temperature sensor	This sensor, which contains a thermistor, detects the temperature of the intake air. The engine-ECU <M/T> or engine-CVT-ECU <CVT> makes fuel injection volume corrections that suit the intake air temperature, in accordance with the voltage that is output by this sensor.
Engine coolant temperature sensor	This sensor, which contains a thermistor, detects the temperature of the engine coolant. The engine-ECU <M/T> or engine-CVT-ECU <CVT> determines the warm-up condition of the engine in accordance with the voltage that is output by this sensor, in order to control the fuel injection volume, idle speed, and ignition timing.

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Name	Function
Throttle position sensor <main, sub>	This sensor detects the position of the throttle valve and inputs it into the engine-ECU <M/T> or engine-CVT-ECU <CVT>. Based on the voltage that is output by this sensor, the engine-ECU <M/T> or engine-CVT-ECU <CVT> effects throttle valve feedback control.
Accelerator pedal position sensor <main, sub>	This sensor detects the position of the accelerator and inputs it into the engine-ECU <M/T> or engine-CVT-ECU <CVT>. Based on the voltage that is output by this sensor, which determines the accelerator position (and the intention of the driver), the engine-ECU <M/T> or engine-CVT-ECU <CVT> effects appropriate fuel injection and throttle valve position controls.
Camshaft position sensor	This sensor detects the top-dead-center (TDC) of the compression stroke of each cylinder.
Crank angle sensor	This sensor detects the crank angle and inputs it into the engine-ECU <M/T> or engine-CVT-ECU <CVT>. The engine-ECU <M/T> or engine-CVT-ECU <CVT> effects injector control and other controls in accordance with the signals received from this sensor.
Detonation sensor	This sensor, which contains a piezoelectric element, detects the vibration of the cylinder block that results from knocking. The engine-ECU <M/T> or engine-CVT-ECU <CVT> detects only the knocking of the engine from these vibrations, in order to retard the ignition timing in accordance with the strength of the knocks.
Alternator FR terminal	This terminal is used for detecting the duty cycle ratio that energizes the alternator field coil.
Inhibitor switch <CVT>	This is a contact point type switch that inputs a signal into the engine-CVT-ECU to determine whether the shift lever is in the neutral position.
Stop lamp switch	This is a contact point type switch that detects how the brake pedal is depressed.
Actuators	
Engine control relay	This relay turns ON and OFF the engine-ECU <M/T> or engine-CVT-ECU <CVT> power circuit.
Throttle valve control servo relay	This relay turns ON and OFF the actuation power circuit for the throttle valve control servo in the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Injector	The injectors inject fuel in accordance with the injection signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Ignition coil (with power transistor)	Applies ignition coil primary current intermittently in accordance with the ignition signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>, in order to generate high voltage for ignition.

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Name	Function
Fuel pump relay	Controls the power supplied to the fuel pump in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
A/C compressor relay	Controls the operation of the A/C compressor in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Purge control solenoid valve	Controls the flow rate of the purge air introduced into the inlet manifold in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
EGR valve (stepper motor) <CVT>	Controls the EGR flow rate in accordance with the signals received from the engine-CVT-ECU.
Alternator G terminal	Controls the amount of current generated by the alternator in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Cooling fan control relay	Controls the rotation of cooling the fan in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Throttle valve control servo	Controls the throttle valve position in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.
Oil feeder control valve	The oil feeder control valve, which is actuated by the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>, controls the valve timing.
Oxygen sensor heater <front, rear>	Turns ON and OFF the oxygen sensor heater circuit in accordance with the signals received from the engine-ECU <M/T> or engine-CVT-ECU <CVT>.

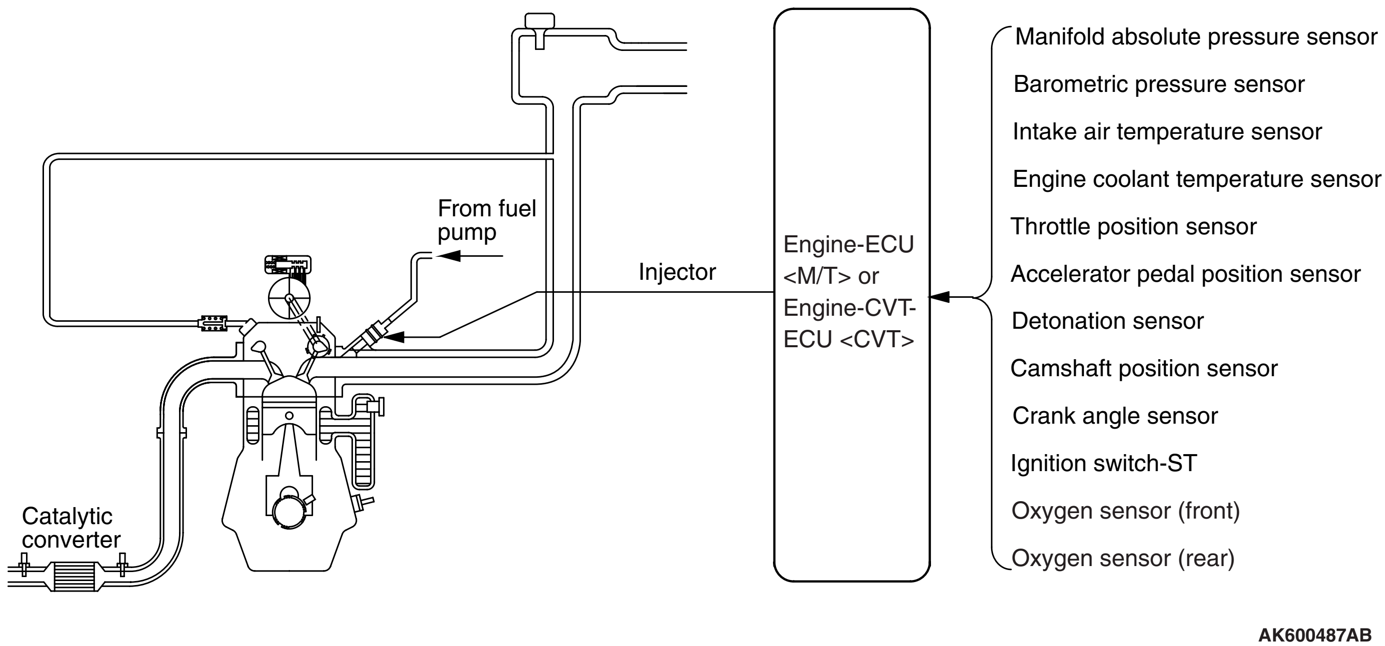
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FUEL INJECTION CONTROL

M2132003000840

This control system is basically the same as that of the 4G1-Non-Turbo engine used in the COLT.

System Configuration Diagram



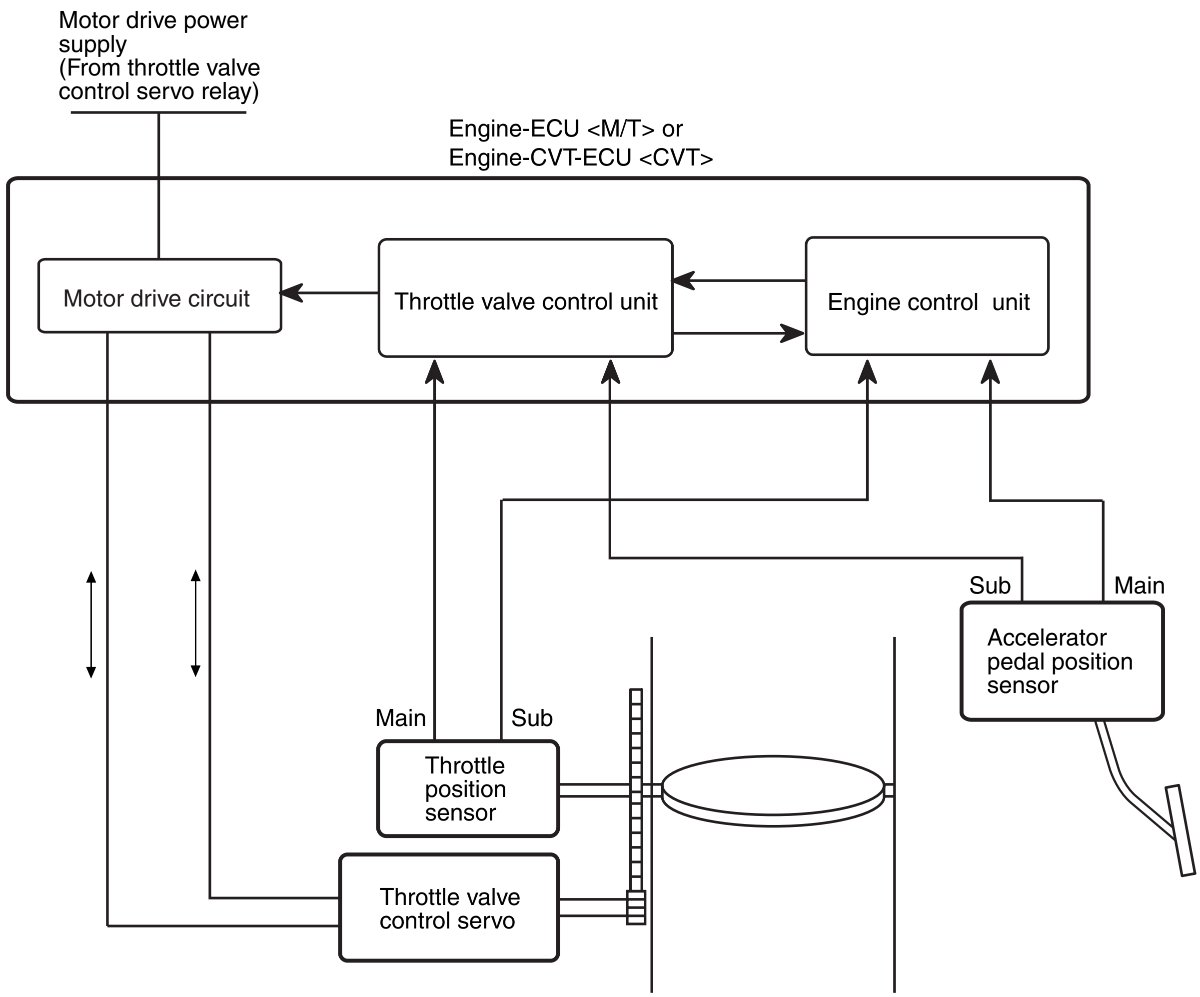
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THROTTLE VALVE OPENING ANGLE CONTROL AND IDLE SPEED CONTROL

M2132003500191

These control systems are basically the same as those of the 4G1- Non-Turbo engine used in the COLT.

System Configuration Diagram



AK401884AE

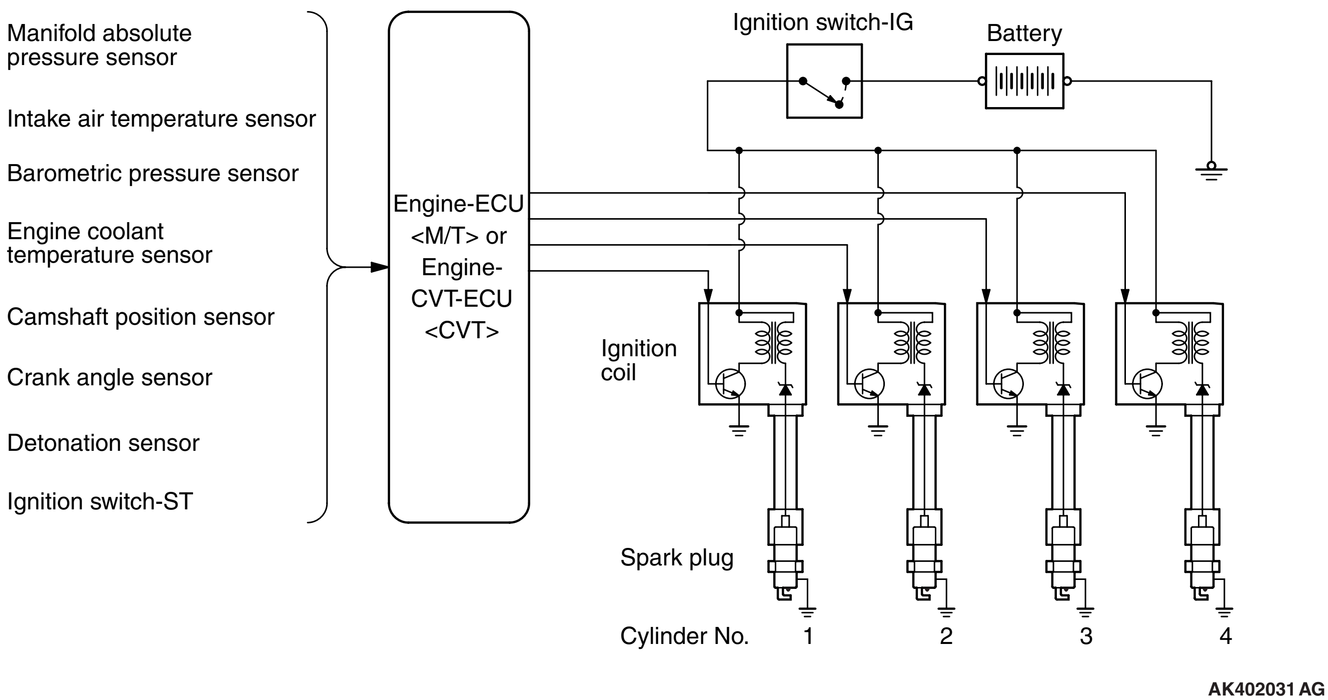
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IGNITION TIMING AND DISTRIBUTION CONTROL

M2132005000750

This control system is basically the same as that of the 4G1-Non-Turbo engine used in the COLT.

System Configuration Diagram



OTHER CONTROL FUNCTIONS

M2132010000596

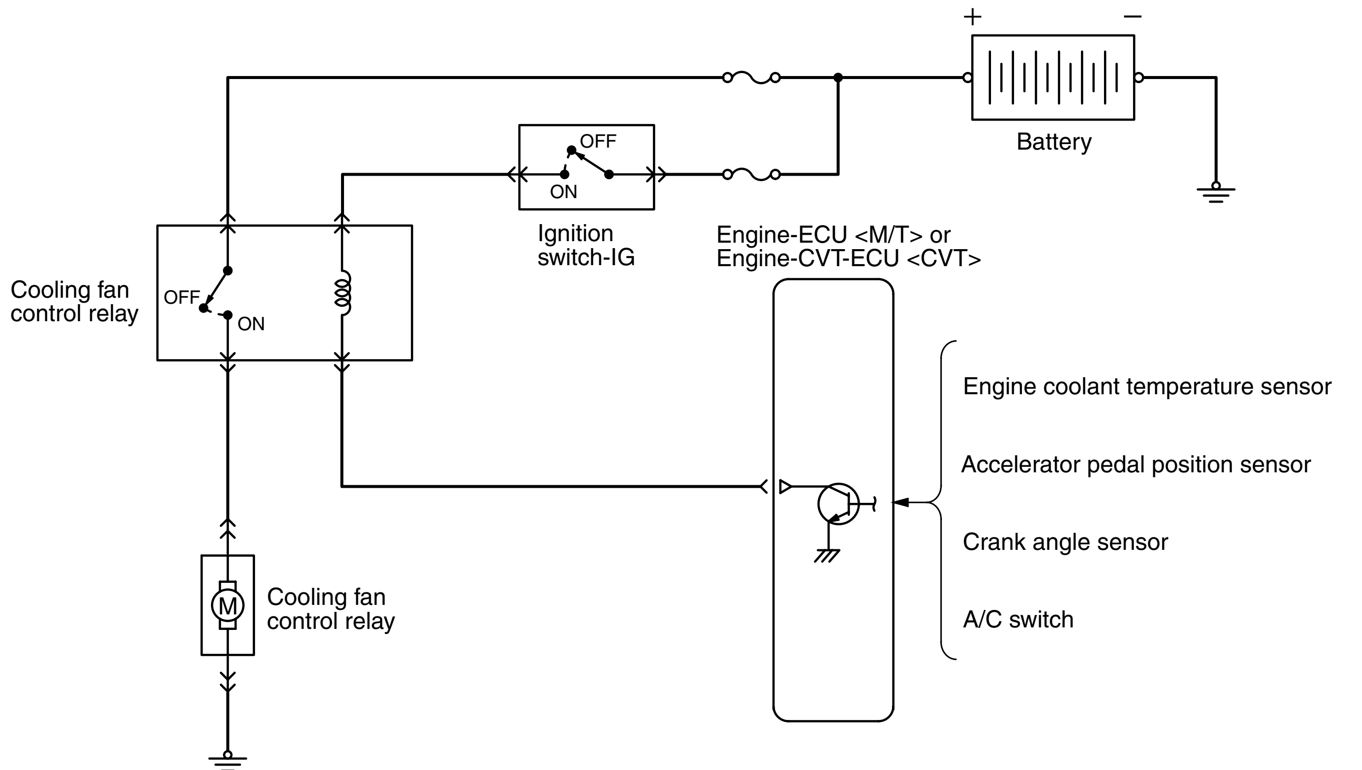
The following controls are basically the same as those of the 4G1-Non–turbo engine used in the COLT.

- ENGINE CONTROL RELAY CONTROL
- THROTTLE VALVE CONTROL SERVO RELAY CONTROL
- MIVEC (Mitsubishi Innovative Valve Timing Electronic Control System)
- FUEL PUMP RELAY CONTROL
- OXYGEN SENSOR HEATER CONTROL
- A/C RELAY CONTROL
- ALTERNATOR CONTROL

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FAN RELAY CONTROL

M2132026400117



AK402032 AD

A/C switch	Vehicle speed	Engine coolant temperature	Power transistor	Fan operation
OFF	80 km/h or less	Approximately 96°C or more	ON	Rotated
		Approximately 96°C or less	OFF	Stopped
	80 km/h or more	Approximately 105°C or more	ON	Rotated
		Approximately 105°C or less	OFF	Stopped
ON	–	–	ON	Rotated

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CONTROLLER AREA NETWORK (CAN)

M2132019000292

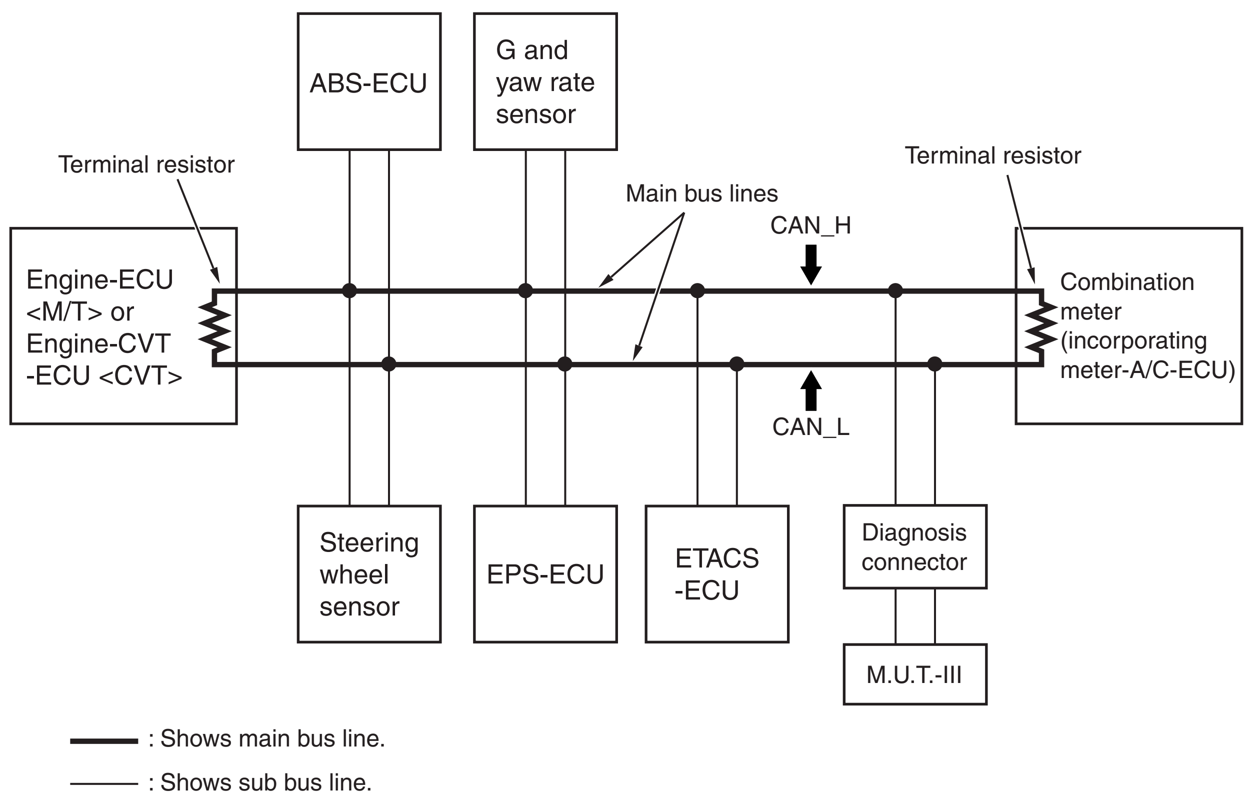
Establishing communication without fail is designed by CAN communication protocol. Refer to Group 54C-CAN P.54C-2 for the details about CAN.

The signals input into engine-ECU <M/T> or engine-CVT-ECU <CVT> are as follows:

CAN Communication Input Signal Table

Input signal name	Transmitter ECU
Motor electric current signal	EPS-ECU
Compressor signal	Meter and A/C-ECU
Idle-up request signal	
Cooling fan request signal	

SYSTEM CONFIGURATION DIAGRAM



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DIAGNOSIS SYSTEM

M2132009000882

Engine-ECU <M/T> or engine-CVT-ECU <CVT> has been provided with the following functions for easier system inspection.

FREEZE-FRAME DATA

When the engine-ECU <M/T> or engine-CVT-ECU <CVT> detects a problem and stores the resulting diagnosis code, the engine condition at that time is also memorized. The M.U.T.-III can then be used to analyze this data in order to increase the effectiveness of troubleshooting. The freeze-frame data display items are given below.

Item No.	Data		Unit
13	Intake air temperature sensor		°C
21	Engine coolant temperature sensor		°C
22	Crank angle sensor		r/min
24	Vehicle speed sensor		km/h
32	Manifold absolute pressure sensor		kPa
44	Ignition advance		deg
81	Long-term fuel compensation		%
82	Short-term fuel compensation		%
87	Calculated load value		%
88	Fuel control condition	Open loop	OL
		Closed loop	CL
		Open loop owing to drive condition	OL-DRV
		Open loop owing to system malfunction	OL-SYS
		Closed loop based on one oxygen sensor	CL-HO2S
8A	Throttle position sensor (main)		%
A1	Oxygen sensor (front)		V
A2	Oxygen sensor (rear)		V

DIAGNOSIS CODE

The diagnosis and engine warning lamp items are given in the table below.

Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0011	Variable valve timing system	Abnormal MIVEC system	–
P0105	Manifold absolute pressure sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0110	Intake air temperature sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0115	Engine coolant temperature sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0122*	Throttle position sensor (main) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P0123*	Throttle position sensor (main) circuit high input	Short-circuit in sensor-related circuits	ON

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Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0125*	Feedback system monitor	Oxygen sensor not operating	ON
P0130	Oxygen sensor (front) system	Open circuit or short-circuit in sensor-related circuits	ON
P0135	Oxygen sensor (front) heater system	Open circuit or short-circuit in heater-related circuits	ON
P0136	Oxygen sensor (rear) system	Open circuit or short-circuit in sensor-related circuits	ON
P0141	Oxygen sensor (rear) heater system	Open circuit or short-circuit in heater-related circuits	ON
P0170	Abnormal fuel system	Leanness or richness problem	ON
P0201	No.1 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0202	No.2 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0203	No.3 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0204	No.4 injector system	Open circuit or short-circuit in injector-related circuits	ON
P0222*	Throttle position sensor (sub) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P0223*	Throttle position sensor (sub) circuit high input	Open circuit in sensor-related circuits	ON
P0300*	Random/multiple cylinder misfire detected	Misfiring	ON
P0301*	No.1 cylinder misfire detected	Misfiring	ON
P0302*	No.2 cylinder misfire detected	Misfiring	ON
P0303*	No.3 cylinder misfire detected	Misfiring	ON
P0304*	No.4 cylinder misfire detected	Misfiring	ON
P0325	Detonation sensor system	Abnormal sensor output	ON
P0335	Crank angle sensor system	Abnormal sensor output	ON
P0340	Camshaft position sensor system	Abnormal sensor output	ON
P0403 <CVT>	Exhaust gas recirculation control system	Open circuit or short-circuit in valve-related circuits	ON
P0421	Warm up catalyst malfunction	Abnormal exhaust gas purification performance of catalyst	ON
P0443	Purge control solenoid valve system	Open circuit or short-circuit in solenoid valve-related circuits	ON
P0500 <M/T>	Vehicle speed sensor system	Open circuit or short-circuit in sensor-related circuits	ON
P0513	Immobilizer malfunction	Open circuit or short-circuit in sensor-related circuits	–
P0603	EEP ROM malfunction	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	–

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Code No.	Diagnosis item	Main diagnosis contents	Engine warning lamp
P0606	Microcomputer malfunction	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	ON
P0622	Alternator FR terminal system	Open circuit or short-circuit in system-related circuits	–
P0638*	Throttle valve control servo circuit range/performance problem	Abnormal throttle valve control servo	ON
P0642*	Throttle position sensor power supply	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	ON
P0657*	Throttle valve control servo relay circuit malfunction	Open circuit or short-circuit in sensor-related circuits	ON
P1021	Oil feeder control valve system	Open circuit or short-circuit in solenoid valve-related circuits	ON
P1602*	Communication malfunction (between engine-ECU <M/T> or engine-CVT-ECU <CVT> main processor and system LSI)	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	ON
P1603*	Battery backup circuit malfunction	Open circuit or short-circuit in system-related circuits	ON
P2100*	Throttle valve control servo circuit (open)	Open circuit in throttle valve control servo-related circuit	ON
P2101*	Throttle valve control servo magneto malfunction	Short-circuit in system-related circuits	ON
P2108*	Throttle valve control servo processor malfunction	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	ON
P2122*	Accelerator pedal position sensor (main) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P2123*	Accelerator pedal position sensor (main) circuit high input	Open circuit in sensor-related circuits	ON
P2127*	Accelerator pedal position sensor (sub) circuit low input	Open circuit or short-circuit in sensor-related circuits	ON
P2128*	Accelerator pedal position sensor (sub) circuit high input	Open circuit in sensor-related circuits	ON
P2135*	Throttle position sensor (main and sub) range/performance problem	Abnormal sensor output	ON
P2138*	Accelerator pedal position sensor (main and sub) range/performance problem	Abnormal sensor output	ON
P2226	Barometric pressure sensor system	Abnormality in engine-ECU <M/T> or engine-CVT-ECU <CVT>	ON
U1073	Bus off	Abnormality in CAN bus line	–
U1102	ABS-ECU time-out	Abnormality in CAN bus line	–
U1106	EPS-ECU time-out	Abnormality in CAN bus line	–
U1108	Combination meter time-out	Abnormality in CAN bus line	ON
U1110	A/C-ECU time-out	Abnormality in CAN bus line	–

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DATA LIST FUNCTION

The data list items are given in the table below

Item No.	Inspection item		Unit
11	Oxygen sensor (front)		mV
13	Intake air temperature sensor		°C
14	Throttle position sensor (sub)		mV
16	Power supply voltage		V
18	Cranking signal (ignition switch-ST)		ON/OFF
21	Engine coolant temperature sensor		°C
22	Crank angle sensor		r/min
25	Barometric pressure sensor		kPa
29	Inhibitor switch		P or N/D, DS, L, or R
32	Manifold absolute pressure sensor		kPa
41	Injectors		ms
44	Ignition advance		BTDC
49	A/C relay		ON/OFF
59	Oxygen sensor (rear)		mV
67	Stop lamp switch		ON/OFF
68	Exhaust gas recirculation valve		STEP
77	Accelerator pedal position sensor (sub)		mV
78	Accelerator pedal position sensor (main)		mV
79	Throttle position sensor (main)		mV
7E	Variable valve timing phase angle		CA
13*	Intake air temperature sensor		°C
21*	Engine coolant temperature sensor		°C
22*	Crank angle sensor		r/min
24*	Vehicle speed sensor		km/h
32*	Manifold absolute pressure sensor		kPa
44*	Ignition advance		deg
81*	Long-term fuel compensation		%
82*	Short-term fuel compensation		%
87*	Calculated load value		%
88*	Fuel control condition	Open loop	OL
		Closed loop	CL
		Open loop owing to drive condition	OL-DRV
		Open loop owing to system malfunction	OL-SYS
		Closed loop based on one oxygen sensor	CL-HO2S

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Item No.	Inspection item	Unit
8A*	Throttle position sensor (main)	%
A1*	Oxygen sensor (front)	V
A2*	Oxygen sensor (rear)	V

NOTE: Items marked "" will not appear if a data list is selected in the check mode.*

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Engine-ECU <M/T> or engine-CVT-ECU <CVT> Monitor Item

- Items useful for grasping the engine control condition by the engine-ECU <M/T> or engine-CVT-ECU <CVT> are provided in this monitor item section.
- Values of these monitor items vary greatly depending on marginal difference of measurement conditions, difference of the environment, aged deterioration of vehicles and so on, and it is difficult to show the precise specification values. Therefore, check conditions, display range and movement of values are described.

Item No.	Inspection item	Display range, numerical value
5A	Air-fuel ratio learning value of B zone (Low speed load)	–25 to 25%
5B	Idle speed control position learned value	–128 to 127STEP
5C	Idle speed control position learned value (A/C load)	–128 to 127STEP
6A	Knock retard	Retards in response to accelerator opening
6B	Learned knock retard	0 – 100%
6C	Target idle speed	Changes in response to engine coolant temperature
9B	Air-fuel ratio learning value of A zone (Low load)	–25 to 25%
9D	Air-fuel ratio feedback integration	–25 to 25%
B2	Alternator G terminal duty	Increases
B3	Purge control solenoid valve duty	0 – 100%
81*	Long-term fuel compensation	–25 to 25%
82*	Short-term fuel compensation	–25 to 25%
87*	Calculation load value	0 – 100%
88*	Fuel control condition	Changes depending on driving condition

*NOTE: *: This item is not displayed when the data list in check mode is selected.*

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ACTUATOR TEST FUNCTION

The actuator test items are given in the table below

Item No.	Inspection item	Drive contents
01	Injectors	Cut fuel to No.1 injector
02		Cut fuel to No.2 injector
03		Cut fuel to No.3 injector
04		Cut fuel to No.4 injector
07	Fuel pump	Fuel pump operates
08	Purge control solenoid valve	Solenoid valve turns from OFF to ON
17	Basic ignition timing	Set to ignition adjustment mode
20	Cooling fan control relay	Drive the fan motor
34	Throttle valve control servo	Stop the throttle valve control servo